



# Rural reform and Fiji's indigenous sugarcane growers: an application of stochastic frontier analysis

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We examine the performance of Fiji's indigenous sugarcane growers, measuring their technical efficiency using a stochastic frontier production function. Of particular interest are the cooperative or communal farming structures among new entrants into Fiji's sugar industry. These structures are emerging in response to government rationalisation policies in agricultural support—from individuals to groups—and the growing emphasis from the indigenous community on economic activity to reflect community requirements, values and imperatives. Our study finds that growers who are members of a cooperative group have higher levels of technical efficiency than growers who live in villages and that their performance is on par with galala or independent growers. Group structures are used as vehicles to centralise management decision-making and pool resources, thereby overcoming experience and capital accumulation constraints. The research also shows that these structures provide a vital mechanism for aligning cultural values and legitimising individual economic activity that has communal benefits. This finding is not only important for Fiji's struggling agricultural sector, it points a way forward for other South Pacific island nations and other countries where agricultural intensification is carried out on communally owned land.

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The main purpose of this article is to examine the technical efficiency of Fiji's indigenous sugarcane growers and provide evidence on factors influencing their performance. A key aspect we examine is the recent emergence of cooperative or communal farming structures that have been promoted by government agencies. These structures consist primarily of landowners who have recently entered the sugar industry as producers.

Sugar is Fiji's main agricultural export and the country's second largest export

revenue earner behind tourism. Historically, the bulk of sugar production has been produced by Indo-Fijian farmers leasing land from the *mataqali* or Fiji's indigenous landowning groups. In the past decade, however, the number of indigenous growers entering the sugar industry has increased significantly, prompted by the expiration of the 30-year agricultural leases from 1997. This trend is likely to continue.

The administration of lease transactions is controlled by a statutory body: the Native Land Trust Board (NLTB).<sup>1</sup> New entrants



to the industry have received government and industry support, including financial grants and elementary training in crop husbandry and management. Additionally, there has been widespread encouragement of new and established indigenous cane growers to adopt traditional concepts to communal work (*solesolevaki*), whereby growers voluntarily pool resources and share information in an effort to improve farm efficiency. The precise number of these groups is difficult to determine as a significant proportion of cane growers regularly shares labour and machinery under informal arrangements. More recently, however, formal arrangements have emerged between new indigenous entrants into the industry as well as established growers. Government assistance through the Farming Assistance Scheme (FAS) administered by the Ministry of Agriculture, Sugar and Land Resettlement (MASLR) and actively encouragement by the NLTB and the Fiji Development Bank (FDB 2003) has seen an increase in the establishment of formal entities.

Any initiative that increases the productive capability of new growers—to counter the loss of experienced tenants—will be important in maintaining the supply of raw cane to the country's ailing sugar mills. The timing is critical as the industry restructures to reduce its dependency on EU sugar subsidies as well as building capacity within the country's rural production base to diversify into alternative products. Under the 1975 Lomé Convention (an agreement between the European Union and African, Caribbean and Pacific countries), Fiji and other African, Caribbean and Pacific (ACP) sugar producers have received preferential prices for a defined quantity of sugar exported to the European Union. Since 2007, the preferential prices under the former Lomé Convention (now the Cotonou Agreement) have been reduced, putting

significant pressure on the restructuring of the production, processing and transport sectors. Recommendations for the reform of the production sector include a major reduction in the number of producers, along with an increase in the average farm size.

Against this background, we examine the impacts of rural economic development policies and agricultural reform programs, including Fiji's cooperative societies, on the indigenous Fijian population. These policies and programs were designed to promote labour specialisation and to mitigate the effects of traditional or cultural obligations that led to inefficient resource use and low technical efficiency.

We hypothesise that technical efficiency will increase where economic activity takes place within a structure that is culturally acceptable *and* facilitates cooperation. The first factor—cultural alignment—is a powerful motivating factor whereby the benefits of economic activity are distributed beyond the individual to the wider group. These benefits can include tangible (for example, cash) and intangible (for example, status in the group) benefits. The second factor—cooperation—includes the sharing of resources among kin farmers to overcome individual deficiencies.

The remainder of this article is organised into four sections. Section two gives a brief overview of the cooperative literature and Fiji's experience with cooperative societies, and examines the influence of Fiji's agricultural and rural reform programs from the colonial period of the late 1800s to the renewal of agricultural leases beginning in the late 1990s. Section three outlines the theoretical and empirical framework, method and data sources; section four discusses the results and section five concludes with policy recommendations.



## Cooperatives and agricultural development in Fiji

### Cooperatives and agriculture

Cooperatives have been a common organisational structure within agricultural sectors of developing and industrialised nations. The term applies to an organisation whose assets are owned collectively by its members or, as defined by Vitaliano (1983:1,079), 'an economic organisation whose residual claims are restricted to the agent group that supplies patronage under the organisation's nexus of contracts'. Chaddad and Cook (2004) point out that in addition to residual claims (that is, the amount left over after all contracted payments to claim holders), ownership includes residual rights of control. Residual control rights are rights to make any decision regarding the use of an asset that is not assigned to other parties by contract.

In the case of cooperatives, the agent group or its members have no individual ownership right to the firm. Instead, they own the monetary value of their shares—leading to one of the main criticisms of cooperatives: collective ownership. Property rights and agency theorists (Alchian and Demsetz 1972; Jensen and Meckling 1979; Fama and Jensen 1983) claim that cooperatives are inherently inefficient because the owners have only vaguely defined property rights, producing a suboptimal structure wherein organisational control is weakened, raising equity is difficult and the use of resources is problematic. An example of a collective ownership problem (or common property problem) in cooperatives is when new members join a cooperative and immediately have access to all assets that earlier members have accumulated. Additional membership dilutes the equity of the existing members (Nilsson 2001). The common property

problem is articulated further by Borgen (2004), who argues that the disparity between a member's contribution of equity and their benefit from the equity leads to free-rider behaviour between members and non-members and between existing and new members.

Williamson's (1985) transaction-cost theory provides an alternative viewpoint on the rationale of cooperative enterprises, arguing that their existence reflects the organisation's efforts to integrate either forwards or backwards in the value chain. Agricultural production and marketing cooperatives are commonly used in agriculture as mechanisms to reduce the production risks associated with: 1) the vagaries of bio-physical production systems; 2) information asymmetry when selling to a monopsonist; or 3) the high transaction costs of selling to multiple independent traders. In these instances, it makes sense for farmers to take advantage not only of scale efficiencies in production but also cooperatively own the trading partner (for example, New Zealand's milk-processing and marketing firm Fonterra is owned by 14,000 supplier dairy farmers).

According to the theoretical arguments, cooperatives should always be less efficient than investor-owned firms; however, empirical studies of cooperatives reveal no definite pattern. One would assume that if cooperatives were inefficient they would be forced out of the market. Their continued existence is partially explained by Porter and Scully (1987), using an empirical study of the US dairy industry. These authors point out that US agricultural cooperatives enjoyed public (or government) support in the form of lower interest rates and tax concessions—although this assistance can be regarded as compensation for efficiency losses in exchange for the socially valuable tasks performed. In spite of the theoretical arguments against cooperatives, their use



in developing and industrialised countries suggests that there will be socioeconomic and political justifications for their existence.<sup>2</sup> For others, socio-cultural reasons—including values such as equality, fairness and solidarity—justify a cooperative structure, even though these reasons often translate into economic advantages as a result of increased volume of product and economies of scale (Nilsson 2001).

### Cooperative societies in Fiji

Cooperatives emerged in Fiji in the 1940s as a vehicle to promote economic activity within villages under the 1947 Co-operative Society Ordinance. By 1959, there were 87 cooperatives; in 1965, there were 239; and by 1970, there were 600 (*Fiji Parliamentary Paper*, no.3, 1971–72, cited in Walter 1974:149). While popular among Fijian communities and widely promoted by the Fijian administration, cooperatives were beset with flaws. According to Walter (1974), from their inception, these entities lacked any clear foundation for economic accountability or growth. As such, by 1969 the contribution of the cooperative movement to economic development was labelled as ‘insignificant’ by Watters (1969:243).

Cooperatives were also severely criticised by Spate (1959) for their susceptibility to peculation, with many becoming inactive in the 1950s—particularly those established for their prestige value and those hopeful of obtaining government financial assistance (Watters 1969). Watters maintained that the lack of individual initiative by Fijians in the village environment was a major impediment to an organisation that was essentially an association of individuals for mutual benefit. Collectivism was the preferred mode of activity, as it represented a form of entrepreneurship that led to economic rewards without resorting to individualistic, small-scale production and marketing.

### Rural reform: independent (*galala*) farmers and the modernisation of agriculture

Fiji has undergone a series of rural reform programs that included policies to establish cooperative societies in the 1940s, the *galala* program or ‘independent farmer’ initiative in the 1960s and large, state-controlled agricultural development programs in the 1970s. The earliest efforts to reform Fiji’s rural economy began in the late 1800s and early 1900s through the Fijian administration, under which the administration carried out a deliberate program of subjugation under the label of ‘indirect rule’ (France 1969; Macnaught 1982; Knapman 1983; Naidu 1992). Indirect rule institutionalised the Fijian hierarchical élite (chiefs), thereby giving wider acceptance and legitimacy to state policies. An example was the policy that restricted the movement of indigenous Fijians to and from their villages.

This policy not only restricted Fijians to their villages, it bound them to work on the land at the will of their local chiefs in order to pay taxes; Fijians had to seek exemptions to take up commercial agriculture or other types of business activity. Formal approval to move out of the village had to be gained from the district headman (*buli*) or provincial headman (*roko*), giving evidence of £100 annual income and ownership of 3 acres of cultivated land. Those moving out of the village were also required to pay in advance a fee and an additional *commutation rate* of £1 per annum to compensate the village for the loss of their services (Macnaught 1982). Many applicants were rejected or had their permission revoked after annual inspections. There was no financial or technical support for farmers who left the village and little encouragement was given to undertake the risks of commercial agriculture (Frazer 1973).



One of the reasons for restricting the movement of indigenous Fijian villagers was the development of a dual economy: sugar, which was produced by indentured Indian labour, and cash crops produced by the indigenous population. Between 1875 and 1902, income from village produce or village 'government gardens' was collected and sold by tender, with part of the proceeds credited to the government as tax dues and the remainder accumulated as village funds (Knapman 1983:112). The taxes required of the village Fijians were a tax-in-kind in the form of subsistence crop surpluses that were passed from the local chiefs to the Native Administration and on to the Treasury.

Mobility restrictions on indigenous Fijians were relaxed by the time of the 1959 *Spate Report* and the 1960 *Burns Commission Report* that heralded an era of modernisation and industrialisation. A characteristic of this period was the concerted effort to modernise the Fijian economy, including greater government investment in land-based projects. More significant was the turnaround in approach towards the indigenous Fijians. This took the form of institutionalising the traditional system of *galala* or farmers who lived away from the village, by promoting them as independent or free of the burden of obligations. Spate drew on comparisons of productivity between Fijians and Indian tenants between 1953 and 1957 that showed the indigenous farmers' yields were consistently below their Indian counterparts, with the exception of *galala* farmers, who compared favourably (Watters 1969:18–21).

Once again, however, the underlying argument for this government policy was flawed. According to Ward (1960, 1964, 1965), the notion that Fijians needed to be encouraged to move out of the village for their 'own good' was at variance with pre-colonial activity. Ward pointed out that before the restrictions placed on mobility

by the Fijian administration, it was not uncommon for families to shift residence from their village and closer to their garden areas, particularly in times of peace.

Further, detachment from social obligations does not automatically follow physical detachment from village life. Lasaga (1980) pointed out that the opposite often happened—that improved economic development in rural areas had increased the Fijians' ability to meet their obligations. Moreover, the *galala* farmer often had greater amounts of time to spend on commercial agriculture and therefore had a greater capacity to contribute materially to the village, resulting in an increase in status. Most *galala* who attended village ceremonies became substantial benefactors to their villages, supplying bullocks for ceremonies, donating money to fundraising activities and providing conspicuous gifts that brought honour to their villages (Frazer 1973).

Following the *Burns Report's* recommendations, the Fijian government drew up ambitious plans to increase sharply the area under commercial agriculture, using the early drafts of land-use studies of Ward (1965) and the soil survey of Twyford and Wright (1965). The result was the emergence of large-scale agricultural projects such as the Uluisaivou Beef Cattle Scheme, the Dreketi Irrigation Rice Scheme, the Batiri Citrus Project and the Seaqaqa Sugar Cane Development Project (Fiji's largest and most expensive effort to increase commercial agricultural participation among indigenous Fijians). Many of these schemes fell short of their intended objectives and their failures, according to Overton (1987), were due to a lack of understanding of the local environmental and social constraints. Lack of planning and poor implementation were common—even when sound advice was commissioned. The *Atkins Report* (Atkins 1988), commissioned by the Ministry of





Economic Planning and Development, proposed a development approach that emphasised market-led strategies and resource-based development proposals that built on existing small-scale, dispersed projects.

In summary, state policies on rural economic reform and agricultural intensification in Fiji from the late 1800s until recently have been underpinned by an agenda that had the best of intentions for the economic development of the indigenous population but with little understanding of their situation. The focus since the 1960s has been on removing or mitigating the negative impact of culture on economic activity—with minimal impact. Fijians continue to value and celebrate their traditions and kin relationships in ways that can appear extravagant to outsiders. Cultural and traditional obligations are expensive to maintain. Preserving kin relationships was critical to survival in traditional, non-capitalist societies. It would be rash, however, to underestimate their importance in semi-substance societies. Where labour and insurance markets are uncertain and infrastructure (including communications) is underdeveloped, the reliance on traditional mechanisms for economic security and socio-cultural well-being will continue until such time as it becomes surplus to requirements.

### Technical efficiency and stochastic frontier analysis

Stochastic frontier analysis of technical efficiency was proposed independently by Aigner, Lovell and Schmidt (1977), Battese and Corra (1977) and Meeusen and van den Broeck (1977). The stochastic frontier model specification for cross-sectional data can be expressed as in Equation 1.

$$Y_i = f(X_i, \beta) e^{v_i - u_i} \quad (1)$$

In Equation 1,  $Y_i$  is the output of the  $i$ th firm,  $X_i$  is a vector of inputs and  $\beta$  is a vector of parameters to be estimated. This specification allows for a non-negative random component in the error term,  $u_i$ , to generate a measure of technical efficiency. The random error,  $v_i$ , accounts for measurement error and captures random variation in output due to factors beyond the control of firms, measurement error and statistical noise. The error term  $v_i$  is assumed to be independently and identically distributed  $N(0, \sigma_v^2)$  and with mean zero and constant variance. The error term  $u_i$  captures firm-specific technical inefficiency in production specified as in Equation 2.

$$u_i = z_i \delta + w_i \quad (2)$$

In Equation 2,  $z_i$  is a  $(1 \times m)$  vector of explanatory variables that can influence the efficiency of a firm,  $\delta$  is a  $(m \times 1)$  vector of unknown coefficients and  $w_i$  is a random variable such that  $u_i$  is obtained by a non-negative truncation of  $N(z_i \delta, \sigma_u^2)$ . Input variables can be included in Equations 1 and 2 as long as the technical efficiency effects are stochastic (Battese and Coelli 1995). The technical efficiency of production of the  $i$ th farmer in the data-set, given the level of inputs, is defined by Equation 3.

$$\begin{aligned} TE_i &= \frac{E(Y_i | u_i, X_i)}{E(Y_i | u_i = 0, X_i)} \\ &= e^{-u_i} = \exp(-z_i \delta - w_i) \end{aligned} \quad (3)$$



The measure of technical efficiency is based on the conditional expectation given by Equation 3, given the values of the composite error term evaluated at the maximum likelihood estimates of the parameters in the model, where the expected maximum value of  $Y_i$  is conditional on  $u_i=0$  (Battese and Coelli 1988). The corresponding mean technical efficiency of firms in the industry is defined as in Equation 4.

$$TE = \left\{ \frac{1 - \Phi[\sigma_u - (\mu / \sigma_u)]}{1 - \Phi(\mu / \sigma_u)} \right\} e^{-\mu + \frac{1}{2}\sigma_u^2} \quad (4)$$

#### Data sources

Data for this research were collected from 21 group meetings with more than 280 indigenous sugarcane growers, as well as a survey of 167 individual growers for on-farm data. The survey was conducted throughout Fiji's sugar-producing districts over a four-month period between April 2003 and September 2004. A total of 22 focus group meetings was carried out across randomly selected locations in the eight sugar mill districts of Fiji between May and September 2003. Of the 235 people who attended the focus group meetings, 178 were registered sugarcane farmers. A survey was carried out with the registered growers to collect information on the main decision maker and family, plus details on farm management practices, use of labour and farm inputs. Follow-up interviews with another 33 individuals were carried out with farmers who fell into specific groups of interest. Of the 211 farmers surveyed, 42 respondents who indicated at the time of the survey that they would be producing sugarcane in 2003 were not on the Fiji Sugar Corporation's (FSC) 2003 database

of producers. The total number of effective respondents was therefore 169. Farmers surveyed by sugar-producing district were: Lautoka (21), Nadi (6), Sigatoka (4), Ba (49), Tavua (1), Penang (54), Seqaqa (33) and Labasa (22).

#### Empirical model specification

This study applies the single-stage estimation model proposed by Battese and Coelli (1995). The choice between Cobb-Douglas or translog functional forms for Equation 1 was made using the likelihood ratio (LR) test, following Kompas, Che and Grafton (2004), with test statistics given by Kodde and Palm (1986), defined as Equation 5.

$$\lambda_{LR} = 2[L(H_1) - L(H_0)] \quad (5)$$

In Equation 5,  $L(H_1)$  and  $L(H_0)$  are the maximised values of the log-likelihood functions under  $H_1$  and  $H_0$ , respectively. Given that the null hypothesis is true,  $\lambda_{LR}$  has an approximate  $\chi^2_{(J)}$  distribution, where  $J$  is the number of restrictions under  $H_0$ . Testing the null hypothesis of the Cobb-Douglas production function against the general translog specification was done by setting the relevant parameters for squared and interactive terms in the translog form equal to zero. The resulting test statistic of  $\chi^2_3 = 3.06$ , compared with a critical value of 7.04, indicates that we were unable to reject the null hypothesis of the Cobb-Douglas at a 5 per cent level of significance. The Cobb-Douglas functional form was thus selected. Additional hypothesis tests, following Kompas, Che and Grafton (2004), were performed to ensure that technical efficiency effects matter and that the distribution of efficiency terms is half-normal. [Details



are available from the authors on request.] Note that the estimates of the stochastic frontier to follow were also confirmed using a 'random coefficients approach', following Kalirajan and Obwona (1994), allowing for the possibility of non-neutral shifts in the production frontier. Estimated results varied but all technical efficiency rankings remained unchanged.

### Stochastic production function variables

Definitions for the five input variables and four dummy district variations are as follows (Table 1). Sugar cane is the total volume (metric tonnes) of sugar cane, as recorded by the FSC for 2003. This is not exactly a measure of total yield, as a proportion of farms have 'standing cane' or non-harvested cane at the end of the season. Land is the area harvested and includes plant crop area (in hectares) and ratoon, normally classified into years one, two and three or more years, recorded by the FSC for 2003. This figure does not include non-productive land or land used for other crops. Labour includes the total number of hours of family, hired and group labour applied to cultivation, planting, fertilising, manual or hand weeding, and cleaning or dressing the crop before harvesting. The amount of herbicide chemical applied was not included because of the difficulty of obtaining accurate data. Harvesting was not included in the labour calculation as the majority of farmers indicated that they hired substitute cane harvesters. The value of 1 in this category in Table 1 as the minimum number of hours indicates the small number of farmers who did not carry out any crop maintenance or cultivation during the 2003 season, yet were able to harvest a crop.

Capital includes a common value (kW) for the two most valuable capital items of most farmers: bullocks and tractors.<sup>3</sup> Conversion from horsepower (hp) to kilowatts (kW) for tractors is 1:0.745 and

bullock draught power for ploughing is estimated at 0.52kW per bullock. For example, one 30hp tractor equals 22.37kW and two bullocks of approximately 250kg in weight equal 2.08kW (Singh and Partap 1999). Fertiliser is derived from the number of bags that the farmer said was applied per hectare. Although the FSC has a record of the number of bags sold to each farmer, these data were not used. Selling bags of fertiliser to raise cash is not an uncommon practice and therefore farmers were asked about the amount that was applied. Land quality is a binary variable indicating farms with greater than 50 per cent of the total land area in flat land.

Variables on districts relate to the mill districts, by category—District 1 (7): Lautoka Mill; District 2 (8): Rarawai Mill; District 3 (9): Labasa Mill; and District 4 (10): Penang Mill. This variable is a proxy for regional differences associated with climatic variability across the two main islands of Fiji and also the industry infrastructure system support for the growers. Each of the mill districts is made up of sectors.

### Inefficiency model variables

'Farm in cane' is the proportion of the farm land planted to cane and is calculated using the lease area registered with the FSC for sugarcane production and the total area harvested. Residence of farmer (value 1) is a binary variable indicating whether the farmer lives on the farm, otherwise it is zero. 'Otherwise' in this case includes farmers who live in a village or village settlements. Tractor ownership is a binary variable indicating whether a farmer owns a tractor. Ownership includes outright ownership by an owner-operator or part-ownership as a member of a formal or informal group arrangement. Farmers who hired or borrowed tractors made up the largest proportion of the sample (52.9 per cent). Reserve land is a binary variable indicating





whether the farmer leases reserve land or has a *vakavanua* arrangement (informal lease). Information for this variable was derived from NLTB and FSC sources. Farmer responses were inconsistent and showed that the farmers' knowledge of their lease arrangements was not always accurate. Membership of a cooperative group is a binary variable indicating membership in a cooperative; otherwise the farmer lives and farms as an individual in a village.

## Results and discussion

Maximum likelihood estimates of the model (Equations 1 and 2) were obtained using FRONTIER 4.1 (Coelli 1996). Results for the stochastic frontier model are shown in Table 2. All estimated input variables are significant at the 5 per cent level, except for District 4. Input share coefficients sum to 0.360, with land quality and regional variation contributing 0.598.

The output of sugar cane is highly dependent on weather (temperature and rainfall distribution). These differences are captured in the four district dummy variables in the production model. Regional variation

Table 1 Variables for the stochastic frontier and inefficiency model

Variable	Sample minimum	Sample maximum	Sample mean	Sample standard deviation
Sugar cane (tonnes)	3.23	477.72	117.24	89.21
Land (hectares)	0.20	12.00	2.92	1.88
Labour (hours per annum)	1.00	2,701.08	542.25	443.34
Capital (kilowatts)	2.08	41.01	16.52	12.52
Fertiliser (kilograms)	1	7200	882.36	961.88
Land quality (binary)	0	1	0.473	0.500
District 1	0	1	0.159	0.367
District 2	0	1	0.289	0.455
District 3	0	1	0.242	0.429
District 4	0	1	0.278	0.449
Efficiency model variables				
Farm in cane (per cent)	0.0316	1	0.474	0.294
Reside on farm (binary)	0	1	0.520	0.501
Tractor ownership (binary)	0	1	0.215	0.412
Reserve land (binary)	0	1	0.496	0.501
Cooperative group member (binary)	0	1	0.271	0.445



Table 2 **Maximum-likelihood estimates for parameters of the stochastic frontier and technical inefficiency models (Equations 8 and 10)**

Variable	Parameter	MLE coefficient	MLE t-ratio	OLS coefficient	OLS t-ratio
<i>Stochastic frontier</i>					
Constant	$\beta_0$	1.468 (0.082)***	17.837	1.209 (0.125)	9.706
LnLand	$\beta_1$	0.301 (0.024)***	12.638	0.349 (0.039)	8.863
Land quality	$\beta_2$	0.096 (0.026)***	3.663	0.137 (0.043)	3.173
LnLabour	$\beta_3$	0.018 (0.009)**	1.998	0.007 (0.020)	0.344
LnCapital	$\beta_4$	0.038 (0.011)***	3.561	0.019 (0.018)	1.069
LnFertiliser	$\beta_5$	0.013 (0.004)***	2.835	-0.001(0.008)	-0.124
District 1	$\beta_6$	0.164 (0.080)**	2.056	0.333 (0.143)	2.334
District 2	$\beta_7$	0.132 (0.073)**	1.818	0.292 (0.134)	2.173
District 3	$\beta_8$	0.143 (0.077)**	1.855	0.271 (0.138)	1.965
District 4	$\beta_9$	0.063 (0.070)	0.899	0.269 (0.137)	1.963
Constant	$\delta_0$	-1.244 (0.783)*	-1.589		
LnFarm in cane	$\delta_1$	-0.139 (0.063)**	-2.215		
Residence	$\delta_2$	-1.366 (0.519)***	-2.630		
Tractor ownership	$\delta_3$	-0.687 (0.355)**	-1.936		
Reserve land	$\delta_4$	0.193 (0.123)*	1.579		
Cooperative member	$\delta_5$	-2.813 (1.242)***	-2.265		
	$\sigma^2$	0.680 (0.244)***	2.780	0.064	
	$\gamma$	0.991 (0.004)***	233.203		
Ln(likelihood)			48.179		-2.274
Mean efficiency	0.828				
Number of observations	169				

\*\*\* statistically significant at the 0.01 level

\*\* statistically significant at the 0.05 level

\* statistically significant at the 0.10 level

**Notes:** Numbers in parentheses are asymptotic standard errors; the *t*-ratio is asymptotic.



in farmer support infrastructure is also captured in the district dummy variables. These include the level of government assistance (for example, agricultural ministry extension services); industry advisory services (for example, sugar industry farm advisors); and financial assistance (FDB loans and other financial services that could have regional differences).

Other district factors include the distance from the farms to the mills. District 4 is the Penang Mill district, which produced the lowest t-ratio (less than 0.9). A high proportion of the farms included in the survey were from two sectors within the Penang district and included farms that had the greatest distance to transport their cane to the mill. The region's terrain is undulating and hilly, limiting rail transport and placing greater reliance on road transport.

A high proportion of the farmers in these sectors have *vakavanua* titles or leases to reserve lands and therefore do not have the degree of security over their land that allows them to borrow funds commercially. Lack of capital to purchase trucks has seen greater reliance on hired transport (almost without exception from Indo-Fijian owners). These farms are located in the 'wet belt' of the cane-growing region on the northwest coast of Viti Levu and their optimal time for harvest is usually earlier than other areas (June or July). Reliance on hired transport means that harvest is delayed until transport is available, often resulting in lost income and unrecoverable seasonal costs.

The results of the technical inefficiency model based on the asymptotic t-ratios show that residence on a farm (rather than in a village or settlement) and being a member of a cooperative have a highly significant and positive effect on technical efficiency (or a highly significant negative effect on technical inefficiency). Percentages of 'farm under cane' and tractor ownership are significant at the 5 per cent level. Reserve

land has a positive sign, which indicates a positive effect on technical inefficiency (at the 10 per cent level). Gamma ( $\gamma = 0.99$ ) is significant, indicating substantial variance in inefficiency across farms; and the mean efficiency of indigenous Fijian farmers is 82.8 per cent.

The proportion of the farm planted to cane is significant, supporting the argument that farmers with greater investment in sugar cane are more likely to be better producers. Tractor ownership is less significant than the other variables but it does indicate that greater capital investment in machinery improves technical efficiency. Farmers with bullocks might be able to farm profitably and sustainably on small blocks but the physical demands of manual ploughing are an issue for farmers who are, on average, close to 50 years old. Additionally, farmers with bullocks are more likely to be subjected to requests from family to donate their bullocks to village ceremonies.

Reserve land is significant and its positive sign indicates that farmers with formal leases on reserve land (Class J) or informal arrangements on reserve land are less technically efficient. These lease arrangements can be problematic for farmers, particularly with the restrictions imposed when applying for loans. Lack of credit security (collateral) on *vakavanua* and Class J leases has led to increasing pressure from financial institutions and the government for landowners to convert to agricultural leases (Class A), which are under the administrative control of the NLTB. Membership of a cooperative group (either formal or informal) is highly significant. We defer discussion of this result to a later section.

### Farm profiles by efficiency rankings

The farm-level efficiency measures from the frontier estimates, combined with the farm characteristics from the survey data, provide



a profile of indigenous Fijian sugarcane farmers by efficiency ranking (Table 3). Following Kompas and Che (2006), these rankings are arbitrarily divided into 'low' (25 to 82 per cent), 'medium' (82 to 92 per cent) and 'high' (93 per cent and higher).

Caution has to be taken with the interpretation of the results, since the correspondence of the farm characteristics

with high or low efficiency levels could be coincidental and not causal. The results from the inefficiency model in Table 2 are thus more precise and should condition the overall conclusions gained from these profiles. Noteworthy features of Table 3 are the differences in area harvested between the high performers and the medium and low efficiency performers (an average of 23

**Table 3 Summary characteristics of efficiency groups**

Average value of farm features	Unit	Efficiency of farm group		
		Low <25–81%	Medium 82–92%	High >93%
Total output		60.3	114.1	199.7
Land area	ha	2.7	2.7	3.5
Yield (tonnes of sugar cane per hectare)	Tsc/ha	24.5	43.2	61.6
Area of farm planted in sugar cane	%	42.4	49.1	50.8
Area of ratoon cane replanted	%	5.6	17.5	24.9
Land quality (1 = flat; 2 = rolling; 3 = steep)		1.5	1.4	1.7
Total annual labour hours per hectare	hrs/ha	170.0	203.7	198.4
Chemical (herbicide) used by farmers	%	36.4	55.1	54.8
Fertiliser (kilograms) per hectare	kg/ha	312.2	259.2	318.4
Reserve or <i>vakavanua</i> lease	%	53.7	47.1	48.8
Tractor used (hired or borrowed)	%	77.8	51.6	75.7
Tractor owned by farmer or group	%	14.3	21.7	31.0
Age of farmer	yrs	50.1	47.2	51.0
Farming experience	yrs	13.7	15.9	17.3
Contract with FSC	yrs	14.2	13.9	15.1
School years	yrs	8.3	8.0	7.2
Cash crops	%	27.3	35.8	23.8
Reside on farm	%	42.9	53.6	61.9
Tertiary qualifications	%	10.5	2.9	2.4
Trade or technical skills	%	29.8	17.1	21.4
Non-farm income	%	15.8	8.6	21.4
Member of landowning unit	%	80.4	74.3	68.3
Member of management group	%	17.5	20.3	18.4



per cent) as well as the higher total output and yield. Medium producers, on average, have yields 43 per cent higher than low performers and the yields of high performers are 30 per cent higher than those of medium performers. The proportion of land in cane is not noticeably different between the high and medium performers, but the proportion of ratoon cane that has been replaced with plant cane is significant. Land quality, while significant in the efficiency model (Table 2), is not a significant qualitative characteristic that distinguishes efficiency groups.

The total number of annual labour hours per hectare shows no significant difference between the three efficiency groups. This is confirmed from the estimates of the efficiency model. Use of chemicals for weed control was dropped from the efficiency model because of its low level of significance. The efficiency groupings, however, show a marked increase in the use of chemicals by the medium and high performers in comparison with the low performers (an increase of 34 per cent). Fertiliser application shows no significant difference between the groups.

Tractor use by the three groups shows no noticeable difference but tractor ownership is significantly higher among the high performers (31 per cent of high performers compared with 14.3 per cent of low performers). Years of farming experience increase with the higher performers but there is no significant difference in the number of years of supplying sugar cane to the FSC. The proportion of farmers who reside on their farms or in settlements increases with the improvement in technical efficiency (an increase of 21 per cent between low and medium performers and an increase 13.4 per cent between medium and high performers).

Farmers with tertiary qualifications are represented more among the low performers (10.5 per cent compared with 2.4 per cent for

high performers). While the overall number of farmers with tertiary qualifications is low, this result indicates that farmers with alternative skills are likely to seek off-farm employment. This interpretation is corroborated by the higher number of low-efficiency farmers with trade or technical skills (29.8 per cent compared with 21.4 per cent of higher performers). Of interest, however, is the higher number of high performers with non-farm income (21.4 per cent).

In the efficiency model results (Table 2), farming on reserve land (Class J leases) or with *vakavanua* arrangements had a significantly negative influence on technical efficiency (at the 5 per cent level). This result is supported by the slightly higher number of farmers in the low-efficiency group. The low number of farmers in the low-efficiency group who own tractors is also corroborated by the results of the efficiency model.

### Cooperative group membership

Returning to Table 2, membership of a cooperative group produced a significant result in improving technical efficiency ( $t$ -ratio =  $-2.26$ ). This outcome highlights several key issues that require further clarification. We address many of the reasons and qualifications for added efficiency from cooperative group membership in the remainder of this article. As a matter of definition, there are two types of group membership: formal and informal. Most informal groups (often referred to as cooperatives by the growers) are formed primarily to pool resources to purchase a tractor or other capital items that would be too expensive for an individual. This adds to efficiency. Land leases are kept separate, membership is voluntary and there is no mechanism to coordinate production. While this is effective as a mechanism to raise capital, these groups are subject to the problem of common ownership—that is, communal assets are open to abuse. In this





sense, formal groups had several distinct advantages over informal arrangements.

**Cooperative group membership and cultural alignment.** Food production for subsistence use is undertaken by individual families on individually delineated areas of land. Labour is supplied in the main by the family and the extended family with contributions from members of *itokatoka* for labour-intensive functions such as planting and harvest when large numbers of volunteers are needed to carry out important activities in a short period. In these instances, the wider landowning unit (*mataqali*) is called on for assistance.

The Fijian term for cooperative labour is '*solesolevaki*', drawing on traditional practices of cooperation and reciprocity that are built on the maintenance and respect of kinship ties. The recent emergence of cooperative or group farming structures among Fiji's indigenous sugarcane growers and its widespread acceptance has been credited largely to the incorporation of the cultural concept of *solesolevaki* into economic activity. Superimposing a traditional concept on a contemporary context can be problematic as the traditional concept of *solesolevaki* was based on the participants having an equitable (or negotiable) stake in the communally owned resources. Property rights were fluid and rights to land were allocated according to a set of criteria that took into account family requirements. Since the codification of Fijian land and allocation, in the form of leases or traditional arrangements (*vakavanua*), is often fixed for long periods, problems can occur with inequitable distribution. This is often the case with *mataqali* members who have an agricultural lease and are seen as a privileged minority within the *mataqali*.

Notwithstanding this consideration, the integration of a concept that reflects traditional values of reciprocity and cooperation with economic activity has

had an interesting effect on the indigenous rural population. The result is a *cultural alignment*—or the alignment of individual economic activity with collective wealth. More significantly, this alignment also allows individual farmers to cope with the conflicts associated with mixed objectives. Shifting the focus from the individual to the group provides a more acceptable cultural context from which Fijian farmers are able to carry out dual roles. The first is as a member of the clan (*mataqali*) with the responsibilities and obligations of tribal membership. The second is as an individual economic agent. These roles seldom sit comfortably side by side in societies that are undergoing a transition from a subsistence existence to full participation in the market economy. The interaction between cultural legitimacy, group membership and establishing conditions that motivate individual farmer behaviour is complex. The incorporation of cultural concepts and practices in the organisation's mode of practice improves its acceptability with the wider social unit. Farmers belonging to a group in which the resources are collectively owned seem to have greater acceptance and are likely to be better motivated to expend effort in commercial production that has both individual and group benefits (Kingi 2006a, 2006b). This, again, adds to efficiency.

The argument for greater cultural alignment is supported by Overton (1999), who argues for greater recognition of traditional systems in what he calls the '*vakavanua* discourse' that focuses on customary Fijian models and local-level activities. The term *vakavanua* translates as 'the way of the land' and often refers to customary methods of land distribution. Its use also, however, refers to practices that are bound to the land and are specific to a region or locality. Similarly, the word *vanua* has multiple meanings, which include land and place (Ravuvu 1987) as well as the people



in that place and the values and beliefs that people in a particular locality have in common. Increasing cultural alignment and paying greater attention to local values and beliefs are reflected in the acceptance and coordination between the leadership of the cooperative organisation and the leadership of the *mataqali* and *yavusa*. Congruency between tribal leadership and organisational leadership increases the cultural legitimacy of the organisation, improves planning and minimises the negative effects of ceremonial and traditional obligations on farm programs. Legitimate leadership of a farming group increases group status and cultural acceptance, shifting the emphasis from individual economic activity to one where activity and benefits are shared within the community.

The benefits of cultural alignment can be seen in the case of the Naleiwavuwavu Cane Development Scheme (NCDS) in Sabeto (NLTB 2003), where the organisation's leadership is closely aligned with the leadership of the *yavusa*. A deliberate effort is made to encourage village elders to participate in the organisation to 'blend tradition and farming'. Including village leadership in the organisation also assists in the planning of seasonal tasks. Village involvement in the organisation minimises ceremonial and traditional obligations on farm programs. The organisation brings together landowners and farmers and communal activity and, according to the NCDS manager, is 'culturally more acceptable...it's a blend of culture, traditions and business'. Legitimate leadership of a farming group gives the group status in the eyes of the village and cultural acceptance, shifting the emphasis from individual economic activity to one where activity and benefits are shared within the community.

**Cooperative group membership and centralised management.** While the previous section described the socio-cultural advantages of group membership and their influences on the individual farmer's motivation and congruency with traditional tribal social structures, this section describes the direct, tangible factors that impact on the farm business. Taken together, these two sections provide a reasonable explanation for increases in the technical efficiency of growers who are members of a cooperative group.

The first contributing factor is that cooperative group membership provides a mechanism to overcome collectively problems that an individual farmer might face, particularly a farmer who is new to commercial production. Government support of the sugar industry has been rationalised in an effort to lower transaction costs and the risk of loan defaults for the financial sector by requiring new entrants to be a member of a group. This is also a precondition for lending or for financial assistance in the form of establishment grants. Cooperative group membership therefore acts as a communal security mechanism similar to social collateral micro-finance institutions (MFIs) such as the Grameen Bank (Goldberg 2005). Group monitoring reduces the financial risks associated with borrowing funds to purchase expensive capital items—such as a tractor—and reduces the likelihood of default.

A key advantage of group membership is the pooling of resources so that the purchase of expensive capital items can be spread over a larger number of individual farms. There are a number of such mechanisms in practice in Fiji but one that is gaining in popularity is where the individual leaseholders—usually from the same *mataqali* or a neighbouring *mataqali* within the same *yavusa*—amalgamate



their leases under a central management system. The leases remain independent but an agreement is drawn up in which the lessee agrees to participate in a 'scheme'. A fee is paid to the central system to cover administration functions and in some cases a lump sum investment to purchase capital items. These payments are either borrowed funds or establishment grants. The result is greater efficiency in capital resources but at a higher risk to the lessee of agency costs.

The promotion of centralised management systems is not a new concept in the Pacific. Ward and Proctor (1980) suggested a wider application of plantation management systems because they had several advantages over smallholder farming systems, under specific conditions. Ward and Proctor observed that farmers were often able to meet the demands of the market and earn much higher than average incomes and therefore recommended the adoption of a centralised system in which farmers aggregated landholdings under the central control of a single management system.

**Contract farming.** An underlying reason for Ward and Proctor's centralised management system was that it provided a mechanism that was no longer subject to the influences of traditional right holders—that is, the structure limited the claims of communal owners over communal resources. Individuals are at much higher risk of acquiescing to requests for goods/products than an organisational structure (assuming effective internal checks and controls). The corollary of this argument is the need for a structure that buffers the influences of culture on economic activity.

The advantage of a centralised decision-making and management system is the formation of a mechanism that coordinates labour and ensures the efficient use of expensive capital items. For inexperienced growers, the responsibility of farm planning is shifted to an experienced individual

or group of kin farmers in charge of coordination and management. Membership of a group lowers the production risk for the individual. In return, they are expected to contribute their labour when group activities are scheduled and to maintain a financial contribution to the running of the group's administrative function.

The step from centralised management to contract farming is an option open to the lessees and the group structures that have the requisite internal capability. Cooperative groups that evolve into a system in which activities are carried out on each of the farms with minimal input from the individual leaseholder are already emerging. This arrangement allows the lessee to live in the village or on the farm but to have the freedom to participate in communal activities as and when required. The contract farmer is able to take advantage of labour planning and management scheduling to also benefit from the amalgamation of leases into a contiguous single production unit with increased scale efficiencies.

## Policy implications and final remarks

This study indicates that cooperative group membership could provide a mechanism to overcome problems that an individual farmer might face. In particular, increased technical efficiency was seen as a likely result of cultural alignment and centralising of management decision making to improve the coordination of farm inputs and the management of labour. Increased cultural legitimacy based on traditional concepts such as *solesolevaki* improves social acceptability—that is, growers who are members of a group in which the resources are collectively owned seem to have greater acceptance and therefore much greater motivation to focus effort and resources. Groups



with centralised management systems that choose to amalgamate leases into a contiguous single production unit are likely to benefit from scale efficiencies and the pooling of resources to purchase expensive capital items. A single organisation also improves access to debt finance and lowers transaction and administrative costs. In addition, the movement to centralised decision-making enables the transition to contract farming in which key farm management activities can be carried out with minimal input from the individual leaseholder, or the entire production system carried out under contract.

An important proviso, however, is the need for capable, skilled and experienced leaders and managers of these organisations. Communal ownership of a cooperative's resources without adequate control can lead to multiple claims and misuse of important assets. Sharing of farm implements is common among Fijian farmers and in spite of past experiences of mistreated machinery many farmers are reluctant to decline a request from kin. Group ownership of assets shifts responsibility for the item from the individual, and this must be managed effectively.

Although the efficiency gains from a centralised structure can be advantageous, they do not come without risks. One of the key issues facing a formal management group is the potential for corruption and agency problems to emerge if stringent controls are not put in place. In the absence of a system that promotes transparency of information and holds the organisational leadership accountable to its main stakeholders—the farmers—serious problems are likely to occur.

While these organisations have shown the capacity to improve the technical efficiency of indigenous cane farmers and provide a mechanism for capital accumulation, their effectiveness outside the

sugar industry is unknown. The sugarcane farming system lends itself favourably to a centralised management system. Crops with greater husbandry requirements (that is, higher technical skills) are less likely to respond to a mechanised farming approach.

In summary, these forms of organisation have potential to provide an effective structural mechanism for Fijian agriculture. Widespread promotion of them as a panacea for the economic development problems facing Fiji's rural indigenous population should, however, be avoided. Centralised management systems are likely to be more applicable to particular farming systems than others; but wherever they are applied, the quality of leadership and governance will be crucial in minimising agency problems.

## Notes

- <sup>1</sup> The leases were established under the *Agricultural and Landlord Tenants Act 1976 (ALTA)* and the *Native Lands Trust Act (NLTA)*, which has been in place since the establishment of the NLTB in 1940. Under *ALTA*, tenants held 30-year leases with the NLTB and the lease rent was fixed at 6 per cent of the unimproved capital value (UCV). Since the expiration of the *ALTA* leases—beginning in 1997—all land transactions are now administered by the NLTB under the *NLTA*. Under the *NLTA*, tenants have no right of renewal but all new leases are for a 'rolling' five to 10-year term (up to a maximum of 50 years) and can be offered on a sharecropping basis. Rent is established by the NLTB to reflect the 'market price' (Lal, Lim-Applegate and Reddy 2001:16).
- <sup>2</sup> Recent literature evaluating cooperatives in developing and transitional countries includes: Karami and Rezaei-Moghaddam (2005); Ozdemir (2005); Lerman (2004); Bezlepkina, Oskam, Lansink and Huirne (2004); Alvarez (2005); Sabates-Wheeler (2002); and Burger (2001).



- <sup>3</sup> The lack of accurate data on the monetary value of farmers' assets (for example, houses, vehicles, bullocks, tractors and other farm implements) meant that a capital value could be estimated only from a common power factor between bullocks and tractors.

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